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ABSTRACT

There are real opportunities for women in engineering, reflecting demands created by the dramatic rate of change in society. Increasingly complex technology, fast response time, the demands of production and managerial positions, increased levels of education and sophistication of employees, shifts in motivational needs, and new organizational structures are all factors in the rapidly expanding need for engineers. Women provide a previously untapped resource but are in short supply. Women need to make changes in the areas of: goal setting, competition, and job application skills; men in adjustment to working, or more successful wives. Couples should prepare to resolve conflicts over relocation, travel, and the role of the working mother. Industry needs to change in the areas of: stereotyped attitudes, traditional social conditioning, application of motivational factors, minimizing separations from the industrial climate, participation in more co-op programs, flexibility toward married career couples, closer relationships with universities, and broadened career paths for women. There probably will not be enough qualified women engineers for opportunities existing in the 1970's. Dramatic change in industry and educational institutions must occur if we are to respond realistically to the tremendous opportunities for women engineers. (Author/NH)

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OPPORTUNITIES AND CHALLENGES FOR WOMEN ENGINEERS IN INDUSTRY

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INTERNALIZING ACCELERATED SOCIAL CHANGE

Are there real opportunities for women in engineering? The answer is YES! In fact, there are so many opportunities that a better question might be...Will women engineers be able to take maximum advantage of the tremendous opportunities that are available? This is possible, but it probably will not happen within the next ten years...and not for the reasons you might assume.

What must be done, then, to enable women to take maximum advantage of these opportunities? The answer now becomes more complex, for there must be a clearer understanding and a quicker reaction by both industrial organizations and educational institutions to meet the demands created by the dramatic rate of change that our society is undergoing.

The objective of this paper is to point out some of the reasons behind the sudden appearance of these opportunities for women in engineering and what this means in terms of further change on the part of all of us in the future.

In his book, Future Shock, Alvin Toffler states: "In the three short decades between now and the twenty-first century, millions of ordinary, psychologically normal people will face an abrupt collision with the future. Citizens of the world's richest and most technologically advanced nations will find it increasingly painful to keep up with the incessant demand for change that

characterizes our time."[1] He also says: "Even many people who understand intellectually that change is accelerating, have not internalized that knowledge, do not take this critical social fact into account in planning their own personal lives."[2]

If we are to accurately analyze and realistically prepare for the opportunities and challenges for women engineers in industry, we must break away from our perceptions of what exists today and prepare for a future that may appear to be ten or twenty years away, but which will probably arrive within the next few years.

[1]Alvin Toffler, Future Shock (New York, Random House, 1970) p. 9.
[2]Ibid., p. 20.

APPEARANCE OF OPPORTUNITIES FOR WOMEN ENGINEERS

Current Needs for Engineers

The nature of business is changing rapidly. Business is still responsive to the old guideline of "find a need and then develop a product to fill that need". When Henry Ford identified the need for an automobile he had no competition and no pressure to hurry. In today's world, tremendous technology is required to respond in time to produce a good product that meets not only the need itself, but the additional requirements determined by law, governmental regulations, public opinion, profitability and competition. An example of fast response time can be seen in the publishing industry, which took the transcript of the Presidential tapes that was released on a Friday and had them on the stands in paperback books by the following Monday.

Another example of fast reaction time is in the area of automobile emission control where new standards and deadlines were established by the government. A product and associated process had to be developed in a seemingly impossible period of time or face tremendous consequences.

As industrial processes become more complex and as the response time for reacting to marketing needs reduces, industry must, by necessity, utilize more engineering trained personnel to cope with the increase in technological complexity.

Engineers are needed not only in the traditional engineering

functions such as equipment design and process analysis, but also in production and managerial positions. It is becoming increasingly difficult to manage a complex, technically oriented operation without having a solid base of technical knowledge that an engineering background provides.

An additional trend appears to be evolving which makes it imperative for engineers to have better people skills regardless of whether they are individual performers or managers. This change results from increased levels of education, increased sophistication of employees, changing social pressures, a shift in motivational needs (less emphasis on security and money to more interest in a sense of achievement, recognition and interpersonal relations with the supervisor), greater use of project managers and new organizational structures such as the matrix organization.

Philip Lesly states in his book, The People Factor: "Today the emerging need is clearly for the [individual] who combines skill in managing complex structures with sensitivity and knowledge about the vital human climate."[3] Consequently, there is a rapidly increasing need for engineers who have the technical competence, people skills, and the business sense to develop into competent technical or business managers.

[3]Philip Lesly, The People Factor (Illinois, Dow Jones-Irwin, 1974), p. 71.

Shortage of Engineers

Right now there are not enough qualified engineers to fill today's needs. Compounding this problem is the fact that the 1975 engineering graduating class is reported to be approximately 15% smaller than 1974.

The enrollment of men in engineering has been affected by such things as:

a. Mass layoffs of "engineers" in the past. (Unfortunately, the term "engineers" had been used very loosely to include a high percentage of non-degreed people who were included as professional engineers.)

b. Changes regarding military obligations.

c. An increase in the variety of career opportunities.

d. The well-known difficulty of obtaining and maintaining a high grade-point average in engineering.

e. The difficulty of being accepted in engineering and even the attainment of the engineering degree itself.

While the enrollment of men in engineering is expected to increase, it will not be adequate to meet the changing needs of industry.

Women Provide New Resource for Engineering Talent

Industry has found itself suddenly turning to a previously untapped resource of talent which would have been unbelievable only a few years ago -- namely, women. But where are they?

Traditionally, engineering has been a man's world. Women have been socially conditioned from childhood to feel that it is not "ladylike" to be mechanically inclined or to be interested in technical things. The pipeline for developing women engineers, which starts with childhood in the home and ends with industry, is practically empty. The enrollment of women in engineering colleges is growing rapidly, but not at a rate fast enough to meet the opportunities that are being made available in industry.

A quote from Ray Killian's book, The Working Woman, sums up the situation very nicely: "The principal limitation to female opportunity is not prejudice against women, but the limited availability of women with the necessary educational and motivational qualifications for available openings."[4]

Legal Impact on Opportunities for Women

Job opportunities were initially opened up to women by the addition of the word, "sex" to Title VII of the Civil Rights Act of 1964. From that point on it was illegal to discriminate not only because of race, creed, age, color or national origin, but also because of sex. Although women's rights was not as dominant an issue as race during the Sixties, it is proving to be THE dominant issue in the Seventies. The pressure is now on, not only to hire more women, but to have a reasonable proportion of women in the higher echelons of management.

[4]Ray A. Killian, The Working Woman (American Management Association, Inc., 1971) p. 13.

Consequently, many industrial corporations are scrambling to hire more women. The greatest need is for top quality women engineers who have both potential for promotion and whose performance warrants salary increases. However, industry is also concerned that governmental pressures to hire and promote women may lead to some careless hiring or promoting which could result in women being placed in positions where they are not promotable or where their inadequate performance restricts salary increases and possibly even leads to termination. All of these situations represent potential discrimination suits which are expensive, time-consuming and tend to create a very bad public image.

Industrial Dilemma

Thus, industry finds itself facing a dilemma that was created by rapid social and technological change:

a. An increased need for engineers.

b. A decline in available male engineers.

c. A severe shortage of women engineers.

d. Government pressure to hire and promote more women.

CHANGES NEEDED TO MAXIMIZE OPPORTUNITIES FOR WOMEN ENGINEERS

Stereotyping and Oversimplification

Frederick Herzberg states in his book, Work and the Nature of Man, "Man will disintegrate psychologically if he is unable to cope with the tremendous amount of information that he receives and if there is no possibility of giving the data some unified meaning."[5]

Being human, we all tend to fear the unknown and uncertainty. When we fail to understand a complex problem and consequently can't solve it, we tend to massage the facts and rationalize until we are comfortable with our own simplified perception of the facts. We then proceed to find an apparent solution that we can accept.

Oversimplification of problems, myths and stereotyping are some of the products of this form of problem solving. Thus, we hear such statements as:

a. Women are inferior to men.

b. Men and women are equal.

c. Men are "male chauvinist pigs".

d. All women share the same viewpoint of women's liberation.

e. Industry doesn't want women engineers.

f. Universities are responsible for the shortage of women engineers.

[5]Frederick Herzberg, Work and the Nature of Man (Cleveland & New York, The World Publishing Company, 1966), p. 13.

In successfully dealing with the subject of women in engineering, we must recognize and accept such facts as:

a. There are real differences between men and women.

b. All individuals have equal rights, but not all individuals are equal.

c. Neither men nor women can be stereotyped due to the existence of tremendous differences between individuals.

d. Since individuals are different they must therefore be motivated differently.

e. Every individual is constantly undergoing change and the criteria for motivation must be altered accordingly.

f. All universities are not alike.

g. All industrial corporations are not alike.

h. Corporations constitute a legal entity but are in fact made up of many different individuals.

i. Social and technological change will continue at a rapidly accelerating rate.

Change for Individuals

Some women receive their engineering degree and encounter difficulty in obtaining a meaningful job, and too often this results in erroneous conclusions being drawn such as...Industry doesn't really want women engineers or industry discriminates against women. Quite frequently the problem of employment rests with a lack of preparation by the individual. Consequently, additional preparation or change on

the part of the individual is needed if we are to take maximum advantage of the opportunities that await properly prepared women engineers.

A. "[Some] women tend to sell themselves short. They need goals and better personal adjustment in order to progress on the job. Whether because of tradition, repeated disappointments, or actual company limitations, women's expectations of themselves and what they can do are often too low."[6]

B. "When a woman enters the business world, she is, perhaps for the first time, in a position of having to compete with men. And she must be prepared to compete on their terms."[7]

C. Due to their social conditioning, many women are not adequately prepared when seeking initial employment upon graduation from college and should take the time to anticipate and prepare responses for standard recruiting questions such as:

   1. What type of work are you seeking?
   2. What are your career expectations?
   3. Are you mobile?
   4. What percent of time are you willing to travel?

D. Men should be prepared for career wives who may be more successful than they are in terms of salary and position.

[6]Ray Killian, p. 29.
[7]Ibid., p. 22.

E. Working couples should anticipate and resolve any conflicts regarding:

1. A situation where the spouse is asked to relocate.
2. A situation where either spouse (or both) may have to travel.
3. The role and expectations of the working mother.

F. While in school each woman engineering student should attempt to seek co-op, part-time, or summer employment in industrial situations to gain a better understanding of industry and to develop specific interests for the type of industry, company, starting job and career she wants and is best qualified for.

G. If, because of a woman's personal preferences, she anticipates a break in industrial employment, she should consider part-time employment or continuing education which would facilitate future reentry into the industrial environment.

Change for Industry

A. Industry must diligently work to change the attitudes of those individuals who tend to stereotype women and are influenced by inaccurate assumptions regarding them.

B. Industry must be prepared to compensate for the traditional social conditioning which has had varying degrees of influence on women engineers.

C. The same motivational skills are needed for women as for men but managers will need to be more sensitive to identify which motivational factors are applicable to each individual woman, particularly

at the onset of her career. For example, due to her personal circumstances, a woman may be less influenced by money than by the job itself or a sense of achievement. A misunderstood motivational need could lead a manager to draw erroneous conclusions and take subsequent inappropriate actions.

D. To maximize the resource that women engineers represent, industry needs to establish programs which will minimize separations from the industrial climate, encourage women to return to full-time employment at the earliest possible opportunity, and more easily enable women to reenter the industrial environment after significant periods of absence. These programs could consist of:

1. Providing careers that are so stimulating that it is very difficult for a woman to either leave or stay away very long.
2. Specially designed reorientation programs.
3. Educational assistance to refresh and update technical skills and knowledge.
4. Providing part-time employment opportunities that enable the woman to maintain her skills while providing meaningful contributions to industry.
5. Providing incentive programs that make reentry into the full-time industrial climate attractive to both the manager who rehires as well as to the woman engineer herself.

E. To enable women engineering students to gain both exposure and experience in the industrial atmosphere prior to full-time employment, industry needs to participate in more co-op programs, part-time employment and summer employment.

F. Greater flexibility must be shown by industry to facilitate the increased trend toward married couples who are seeking dual careers.

G. Industries need to establish and maintain closer relationships with universities for the purpose of:

   1. Providing funds for meaningful programs that may not be otherwise available to women engineers.
   2. A meaningful exchange of information enabling both industries and universities to more effectively assist women in the academic and work environments.

H. Because of social and technological change, career paths for women need to be broadened beyond the traditional concepts, thus making engineering careers more attractive and more practical.

THE FUTURE HAS ARRIVED

Industrial Change Has Begun

The recommendations mentioned under "Change for Industry" refer to the future and what should happen as opposed to what in fact exists in most industries today. A traditional approach would be to wait and see what actually develops within industry before initiating any action to dramatically increase the number of available women engineers. However, a traditional approach to a non-traditional problem would serve only to heighten the dilemma industry finds itself confronting and would work against the goal of maximizing opportunities for women engineers in industry.

The situation created by the increased need for engineers, the decline in qualified male engineer availability, the existing shortage of women engineers, and the increased pressure by the government to hire women is causing an intense pain within industry that can only be relieved by a rapid change of attitudes, policies, practices and aggressive actions that demolish traditional barriers to women and result in unlimited opportunities for women engineers. The change that must take place within industry has already begun. The demand for women engineers will be increased at a much greater rate than the supply of women engineers can provide.

Tomorrows Needs Arrived Yesterday

The solution to the shortage of qualified women engineers is not simply resolved. In most situations there is a minimum of a 4 1/2 to 5 year time lag between the recognition of existing job opportunities

and for the enrollment-to-graduation process to take place. However, it will be more difficult to attract sufficient numbers of qualified women to enter engineering schools.

A report issued by the Massachusetts Institute of Technology indicates that "Economic forces, education, family, and other social factors all have an impact on women's perception of career opportunities for themselves and society's utilization of them. These reinforce each other and often become self-fulfilling prophecies that restrict opportunities."[8] The report says that the absence of women in science and engineering is also a product of ingrained assumptions about what is women's work. This assumption deters girls from seeking training in mathematics, physics, chemistry and other areas necessary for technical careers.

Consequently, the time lag for responding to industrial opportunities for women engineers becomes extended beyond the normal 4 1/2 to 5 years to at least a minimum of 9 years. If this is true, then it is also true that there probably will not be enough qualified women engineers to take advantage of the abundance of opportunities that will exist throughout the remainder of the Seventies.

[8]Women in Science and Technology: A Report on an M.I.T. Workshop, M.I.T. Publications Office, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139.

SUMMARY

Social and technological change is occurring at such a rapid rate that we face the increasingly difficult task of assessing where we are, internalizing the significance of the change, and determining which course of action is now most appropriate.

Yesterday we were concerned with the lack of enough qualified women engineers to take advantage of the abundance of opportunities that are available. Industry finds itself becoming more heavily dependent on engineers while the supply of male engineers is inadequate. Women represent a tremendous resource, but there are not enough women engineers available to fill either today's needs or the needs that will occur in the next decade. In the meantime, the Government is rapidly increasing pressure on industry to hire more women. The traditional process by which our educational institutions could respond to industrial needs is now inadequate when it comes to women engineers.

Dramatic and sudden change must occur on the part of industrial organizations and educational institutions if we are to realistically respond to the sudden appearance of opportunities for women engineers. We must now create the consciousness and understanding needed to undertake the control of change.

Keep in mind that there are no "problems" regarding women in engineering, only tremendous "opportunities". The exciting challenge that is presented to industrial organizations, educational institutions, individual men and individual women is to rapidly adjust to the sudden opportunities presented to women in engineering and to provide maximum utilization of these opportunities.